Space Weather Technical Forecast

Issued on Monday 14 October 2024 at 01:08 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance G1 Minor Storm day 2 (15 Oct) from possible glancing CME arrival or coronal hole, fast wind onset. Chance of isolated M-flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low activity with only C-class flares observed, peaking C5.7 at 13/0657 UTC from AR3848 approaching the northwest limb. This is the largest of the eight regions on the disc, and has shown some apparent simplification in the period, although this could be due to increasing viewing angle. The other regions remain stable and relatively simple, with perhaps the main flare risk from the combination of AR3852 and AR3854 in the south-centre disc, however these have both seen their intermediate spots fade.

A number of CMEs have been observed in imagery, however these are all off the Earth-Sun line, and not Earth-directed.

Solar Wind / Geomagnetic Activity: A weak solar sector boundary crossing, potentially due to a passing transient, was evident in the solar wind, but had no notable impact. Elevated solar winds eased to be slightly elevated, from around 550km/s to near 400km/s. Density varied from below to around average. Interplanetary magnetic field, Bt, was weak below 6nT throughout, but showed a sudden change around 13/0940 UTC. The north-south component, Bz, also became negative (southward) between 13/0940-2230 UTC, but remained very weak, varying between +3 and -3nT. Phi angle was initially negative (towards the Sun) but switched to positive (away from the Sun) around 14/0940 UTC. Geomagnetic activity was Quiet (Kp0-2).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at background. High energy electron flux (greater than 2MeV) observed by GOES16 was persistently Moderate with peak 380 pfu at 13/2020 UTC. The associated 24-hour fluence was below the Active threshold with a slight rising trend. The 14/0000UTC observed was 1.43e7 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected with a chance of isolated M-class flares and a slight chance of X-class flares.

Solar Wind / Geomagnetic Activity: There is a chance of a glancing impact from the CME early day 2 (15 Oct). There are no other Earth-directed CMEs in the forecast. Slightly elevated winds are expected to continue gradually easing to background, however there is a slight chance of a fast

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wind enhancement from CH79/+ day 2 (15 Oct), although this is low confidence. Mainly Quiet geomagnetic activity is forecast with Unsettled intervals. Any coronal hole or CME enhancement brings the chance of Active to G1 Minor Storm intervals.

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES-18 is now largely at background, but there remains a slight chance of further enhancements given any significant flares from AR3848 or potentially the combined AR3852/54. High energy electron flux is expected to continue rising as solar winds ease and the Van Allen belts expand outward again. This brings a chance of High flux, especially before any possible CME arrival or CH fast wind onset day 2 (15 Oct). The associated 24 hour fluence is expected to rise, but likely remaining below Active (1e8 total pfu).

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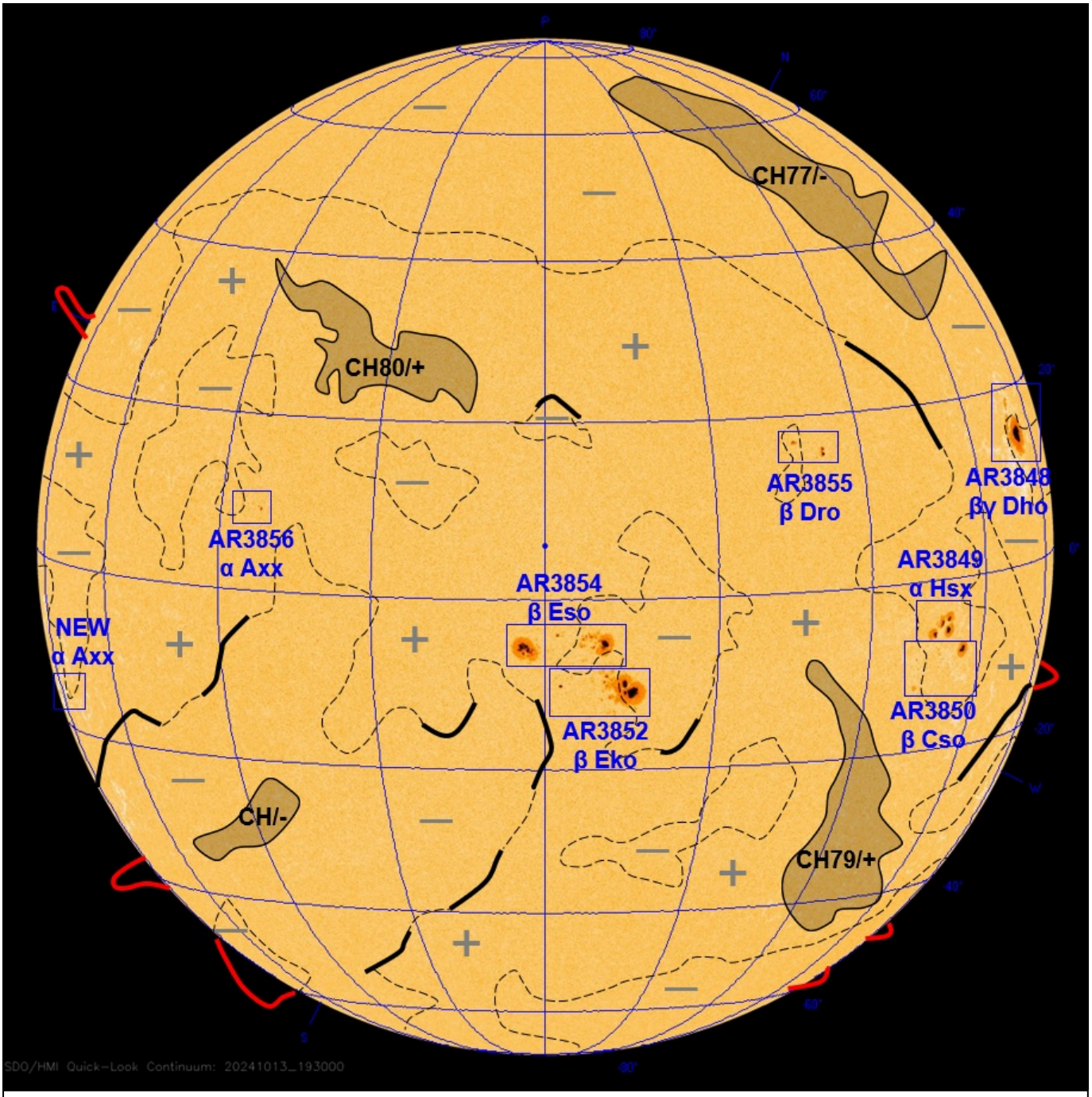
Figure 1: Solar Synoptic Map 13/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There is one potential Earth glancing CME. This originated from an M2.1 from from AR3854 in the east disc, with a glancing impact most likely on day 2 (15 Oct). This is low confidence, due to limited imagery for analysis, and the eastward directed CME, with much of the material passing behind (east of) Earth.

Otherwise, the ongoing slightly elevated solar winds are expected to continue gradually easing towards background. However, there is a potential for slightly elevated to elevated winds to return for a time on day 2-3 (15-16 Oct) due to a connection to coronal hole fast winds from the southern disc CH79/+. While this was present on the previous rotation and showed no notable enhancement, it is now slightly different in shape with a slight northward extension, and is likely stronger on this occasion due to its persistence. However, confidence remains low for this being observed, with Earth currently north of the ecliptic, and also MOSWOC Enlil is providing little guidance. This is currently over-estimating the extent of a non-existent broad fast wind from the southern disc, likely due to current limitations with GONG H-alpha imagery that is used for the initialisation of the model.

Mainly Quiet with a chance of isolated Unsettled intervals throughout. There is chance for a spell of Active to G1 Minor Storm from any CME arrival or coronal hole onset day 2 (15 Oct), easing again day 3 (16 Oct)

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	30	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R⊙ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
12/0102	Nil	AR3854	27E 01S	480	Early 15 Oct	Low confidence. Glancing impact at most.

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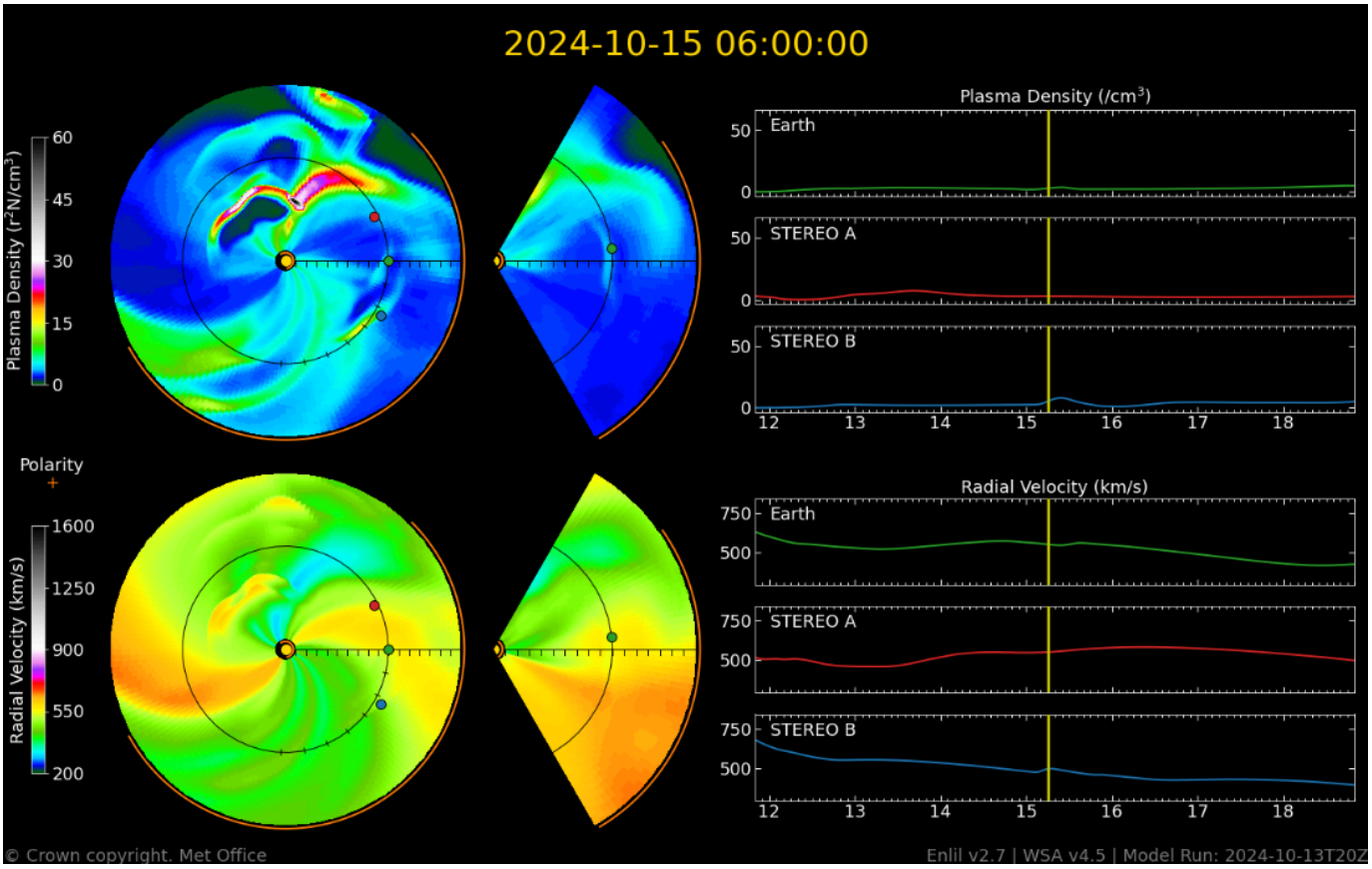
Figure 2: MOSWOC Enlil, showing weak CME glance.



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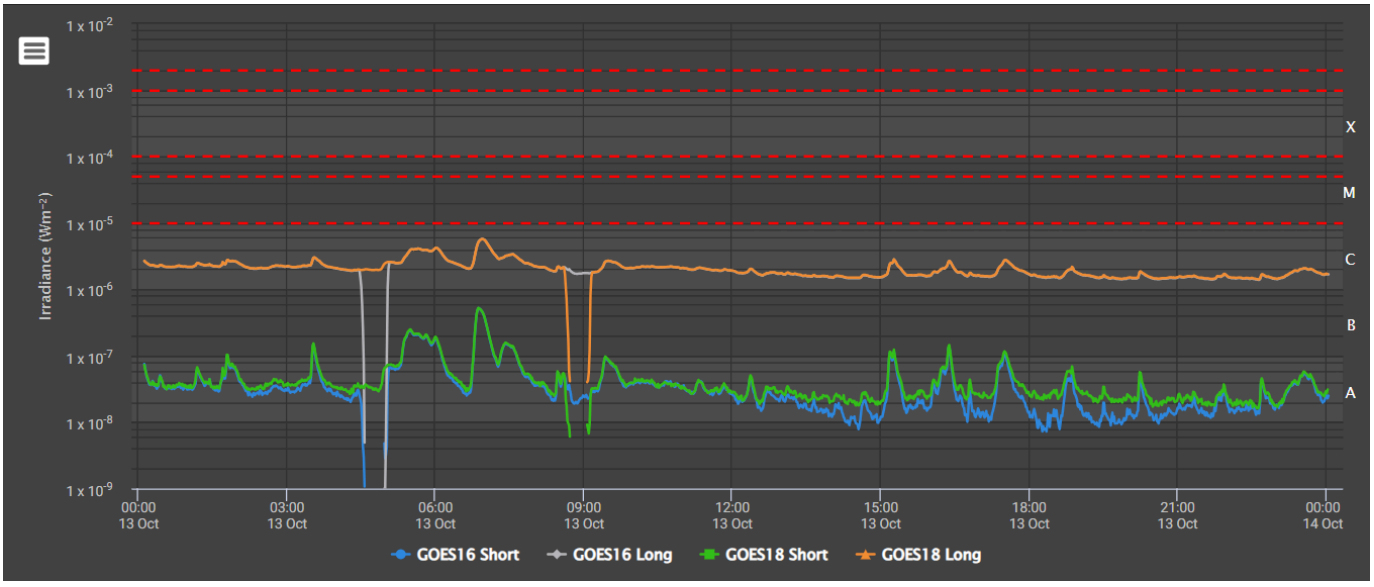
Radio Blackouts - X-Ray Flares

Low to Moderate activity is expected to continue with a likelihood of isolated M-class flares and a slight chance of X-class flares. These most likely from AR3848, or perhaps from the combination of AR3852 and AR3854.

There are eight sunspot regions on the Earth facing disc, however all are relatively simple and stable. AR3848 remains of interest, as the largest spot on the disc, however this has been largely inactive aside from the X1.8 on 09 Oct. This is also now hard to observe, and is now approaching the northwest limb. AR3852 and AR3854 in the south-centre form a coupled pair of sunspots. While also relatively inactive and having shown some simplification with the loss of intermediate spots, the regions continue to show some interconnected magnetic loop structure in e.g. SDO aia-211. There is also a filament extending from these two regions and across the southeast disc, evident in SDO aia-304, although more broken in H-alpha imagery. AR3850 and AR3849 in the southwest also form a closely connected pair of spots, but are now largely consisting of a cluster of negative polarity spots with few very small positive polarity spots identifiable. The other three regions, including the new region on the southeast limb, are much smaller and simpler with little growth evident.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	No	50	50	50	50
Very Active	R3-R5 (X Class)	No	10	10	5	5

Figure 3: GOES-16/18 X-ray Irradiance



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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is expected to remain at background, but maintains a slight chance of further enhancement given any further notable flares, primarily from AR3848, but also possible from any AR3852/54 flare, especially as it moves further onto the western disc.

Any enhancement will bring a slight chance of reaching the S1 Minor Radiation Storm threshold.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES-16 is currently persistently Moderate. The recent CME arrival and subsequent strong solar winds has likely increased counts at lower orbits, with the Van Allen belts compressed inward by the ongoing solar wind pressure. As solar winds ease, flux is expected to rise at GEO to become Moderate to High with a chance of becoming persistent High by day 2 (15 Oct). However, this is low confidence, and confidence is further lowered by the potential glancing CME arrival later on this day. Any such arrival is likely to drop out the flux at GEO to background again, with any subsequent enhancement low confidence

The associated electron fluence is expected to be below the Active level (1e8 total pfu), but with a rising trend. This will bring a slight chance of Active fluence, most likely day 2-3 (14-15 Oct) before the subsequent CME arrival reducing the potential for Active fluence. REFM shows a steady trend for the next 24 hours, however the day 2-3 period continues to show the potential for enhancement.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	10	20	10	5
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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Figure 4: GOES16 Electron Flux and Fluence with REFM and Recurrence

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